

New US Patent Application filed September 29, 2006
Preliminary Amendment

Amendments to the Specification

Please insert the following new paragraph and subtitle immediately following the title of the application on page 1:

This application claims priority to PCT/EP2005/002855, filed on March 17, 2005, which claims priority to DE102004016764.8 filed on April 1, 2004.

Technical Field

Please add the following subtitle at line 5 on page 1 with the following :

Background

Please amend the paragraph beginning on line 6 page 1 with the following amended paragraph:

Control ~~Regulator~~ devices for gas valves must be fail-safe. If the state of the control ~~regulator~~ device is undefined, then it must be guaranteed that in this undefined state a gas valve controlled by the control ~~regulator~~ device does not open. If, for example, a microprocessor is used as the control ~~regulator~~ device for gas valves, then the use of a fail-safe circuit may help ensure ~~guarantees~~ that the whole arrangement is fail-safe.

Please amend the paragraph beginning on line 15 page 1 with the following amended paragraph:

Recently, piezo-operated gas valves have been used, particularly in low-voltage applications such as water heaters without a mains connection. The piezo-operated gas valves are often controlled by a control ~~regulator~~ device in the form of a microprocessor. In such low-voltage applications, the supply voltage is often approximately 3 volts, which can be provided by

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a battery. However, a voltage of typically at least 150 volts is required to open the piezo-operated gas valves. Accordingly, a fail-safe circuit is often desirable ~~required~~ for low-voltage applications of this kind, which, on the one hand, provides an output voltage of at least 150 volts to open the piezo-operated gas valves from a low supply voltage of approximately 3 volts, and, on the other, only generates the output voltage required to open the piezo-operated gas valves if the control ~~regulator~~ device, often in the form of a microprocessor, is in a defined state to open the gas valves.

Please delete the paragraph beginning at line 34, page 1 which starts with "Starting from this,".

Please add the following new subtitle at line 37, page 1:

Summary

Please amend the paragraph beginning on line 38 page 1 with the following amended paragraph:

~~This problem is solved by means of a fail safe circuit for gas valves with the characteristics of Claim 1.~~ According to one illustrative embodiment the present invention, ~~the~~ a fail-safe circuit includes at least one input that can be connected to a control ~~regulator~~ device and at least one output that can be connected to a gas valve, where the fail-safe circuit only supplies an output voltage that is required to open a gas valve to the, or to each output, if an input signal containing at least two different, successive frequency signals is applied by the control ~~regulator~~ device to an input of the fail-safe circuit.

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Please amend the paragraph beginning on line 12 page 2 with the following amended paragraph:

In some cases, ~~In terms of the present invention,~~ a fail-safe circuit is created for gas valves, in particular for piezo-operated gas valves, which, on the one hand, is able to provide an output voltage of more than 150 volts that is required to open piezo-operated gas valves from a supply voltage of only approximately 3 volts, and, on the other, only provides this output voltage required to open the piezo-operated gas valves if the control ~~regulator~~ device is in a defined state to open the gas valves. ~~The~~ One illustrative fail-safe circuit ~~according to the invention is~~ may be characterized by a simple design and can ~~therefore be~~ implemented cost-effectively.

Please amend the paragraph beginning on line 25 page 2 with the following amended paragraph:

According to one illustrative embodiment ~~a preferred improvement of the invention,~~ the fail-safe circuit may include ~~has~~ a charging circuit and a voltage transformer circuit, but this is not required. The charging circuit may have ~~has~~ at least one capacitor, where the charging circuit charges the one or more capacitor ~~or each capacitor~~ in the charging circuit when a first frequency signal is applied or is present in the input signal. On the other hand, when a second frequency signal is applied or is present, the one or more capacitors ~~or each capacitor~~ in the charging circuit discharge[[s]]. In some cases, ~~The~~ voltage transformer circuit produces an output voltage that is required to open the gas valve from a supply voltage when the second frequency signal is applied or is present in the input signal. The voltage transformer circuit may have ~~has~~ at least one capacitor, which charges when the second frequency signal is

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present in the input signal, and which discharges when the first frequency signal is present in the input signal, and hence maintains the output voltage required to open the gas valve more or less unchanged for a period of time.

Please add the following new subtitle immediately following the paragraph ending on page 3 line 5:

Brief Description

Please delete the paragraph beginning at line 7, page 3 which starts with "Preferred improvements of".

Please add the following new paragraph at line 12 of page 3:

The invention may be more completely understood in consideration of the following detailed description of an illustrative embodiment of the present invention in connection with the accompanying drawings, without being restricted to this or other illustrative embodiment, in which:

Please amend the paragraph beginning on line 13 page 3 with the following amended paragraph:

Fig. 1 ~~Fig. 1~~ shows a circuit diagram of a fail-safe circuit for gas valves according to one illustrative embodiment of the present invention.

Please add the following new subtitle immediately following the paragraph ending on page 3 line 14:

Description

Please amend the paragraph beginning on line 16 page 3 with the following amended paragraph:

An illustrative embodiment of the ~~The~~ present invention is described in greater detail below with reference to Fig. 1.

Please amend the paragraph beginning on line 19 page 3 with the following amended paragraph:

Fig. 1 shows a fail-safe circuit 10 for gas valves according to one illustrative embodiment ~~the invention~~, in particular for ~~in~~ low-voltage applications. Possible examples of such low-voltage applications are water heaters without a mains connection in which piezo-operated gas valves are used. In such low voltage applications, a supply voltage is typically provided from a battery or from a generator integrated within the water circulation, the supply voltage in such applications is often ~~being~~ about 3 volts. In Fig. 1 the supply voltage is identified with V_{BAT} .

Please amend the paragraph beginning on line 30 page 3 with the following amended paragraph:

In the ~~preferred exemplary~~ illustrative embodiment of Figure 1, the fail-safe circuit 10 ~~according to the invention~~ has an input to which a control ~~regulator~~ device sometimes in the form of a microprocessor can be connected, and two outputs 12 and 13, from which a supply voltage $\pm V_{OUT}$ is output for a gas valve. Depending on the signal from the control ~~regulator~~ device, which is applied to the input 11 of the illustrative fail-safe circuit 10 of Fig. 1 ~~according to the invention~~, the circuit may generate[[s]] the output voltage V_{OUT} that is necessary to open the gas valve using the supply voltage V_{BAT} , which is approximately 3 volts, namely only when an input signal containing at least two different[[,]] successive frequency

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signals is supplied by the control ~~regulator~~ device to the input 11 of the fail-safe circuit 10.

Please amend the paragraph beginning on line 8 page 4 with the following amended paragraph:

The illustrative fail-safe circuit 10 of Fig. 1 ~~according to the invention~~ has a charging circuit 14 and a voltage transformer circuit 15. The charging circuit 14 and the voltage transformer circuit 15 contain the components enclosed by chain-dotted lines in Fig. 1.

Please amend the paragraph beginning on line 14 page 4 with the following amended paragraph:

The charging circuit 14 of the illustrative fail-safe circuit 10 includes a capacitor 16, where two diodes 17 and 18 are connected in parallel with the capacitor 16. A resistor 19, which is connected to the input 11 of the fail-safe circuit 10 via a capacitor 20, is connected between the two diodes 17 and 18.

Please amend the paragraph beginning on line 21 page 4 with the following amended paragraph:

As can be seen in the illustrative embodiment of ~~from~~ Fig. 1, a transistor 22 is connected to the input 11 of the fail-safe circuit 10 via a resistor 21, the transistor 22 being designed as a bipolar transistor, namely as an NPN transistor in the illustrative embodiment. The base of the transistor 22 is connected to the input 11 of the fail-safe circuit 10 by means of the resistor 21. Connected to the capacitor 16 of the charging circuit 14 is a further resistor 23, which in turn is linked to the collector of the transistor 22 and the base of a

transistor 24 of the voltage transformer circuit 15. The transistor 24 is in turn designed as a bipolar transistor, namely as an NPN transistor in the illustrative embodiment.

Please amend the paragraph beginning on line 34 page 4 with the following amended paragraph:

In the illustrative embodiment of ~~According to~~ Fig. 1, the emitters of the two transistors 22 and 24 are connected together. As well as the transistor 24 already mentioned, the base of which is connected on the one hand to the collector of the transistor 22 and, on the other, by means of the resistor 23 to the capacitor 16 of the charging circuit 14, the voltage transformer circuit 15 furthermore contains a comparator 25, a coil 26, a diode 27, a capacitor 28, a resistor 29 and a further transistor 30. The transistor 30 is designed as a field effect transistor or a MOSFET transistor in the illustrative embodiment.

Please amend the paragraph beginning on line 8 page 5 with the following amended paragraph:

As can be seen from Fig. 1, the coil 26 is connected on the one hand to the supply voltage V_{BAT} and, on the other, to the so-called drain of the transistor 30, which is designed as a self-blocking field effect transistor in the illustrative embodiment. An anode of the diode 27 is connected between the coil 26 and the drain of the MOSFET transistor 30, whereas the cathode of the diode 27 is connected to the output 12. The source of the MOSFET transistor 30 is shown connected to the output 13, while the capacitor 28 of the voltage transformer circuit 15 is shown connected between the outputs 12 and 13 of the fail-safe circuit 10. As can also be seen from Fig. 1, the output of the

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comparator 25 connects to the gate of the MOSFET transistor 30 while the input of the same is connected to the collector of the bipolar transistor 25. Furthermore, the collector of the transistor 24 is connected by means of the resistor 29 to the coil 26 and thus to the supply voltage V_{BAT} .

Please amend the paragraph beginning on line 27 page 5 with the following amended paragraph:

As already mentioned, the fail-safe circuit 10 may only generate[[s]] an output voltage of over 150 volts that is required to open the gas valve at the outputs 12, 13 if a signal containing at least two different[[,]] successive frequency signals is provided by the control ~~regulator~~ device at the input 11 of the fail-safe circuit 10. In this case, a defined operating state of the control ~~regulator~~ device for opening the gas valve exists.

Please amend the paragraph beginning on line 36 page 5 with the following amended paragraph:

In the illustrative ~~preferred-exemplary~~ embodiment, the input signal may contain[[s]] two frequency signals, namely a first frequency signal with a frequency of about 500 kHz and a second frequency signal with a frequency of about 10 kHz, which are present or are applied successively in the signal provided by the control ~~regulator~~ device in such a way that a time period of about 30 milliseconds with the first frequency signal of about 500 kHz is respectively followed by a time period of about 100 milliseconds with the second frequency signal of about 10 kHz.

Please amend the paragraph beginning on line 10 page 6 with the

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following amended paragraph:

The illustrative fail-safe circuit 10 of Fig. 1 ~~now~~ may work in such a way that when the first frequency signal of about 500 kHz is applied or is present at input 11, the charging circuit 14 charges the capacitor 16 of the same. While the second frequency signal of about 10 kHz is applied to the input 11, the capacitor 16 of the charging circuit is not charged but rather a discharge of the capacitor 16 takes place via the resistor 23 and the base of the transistor 24. The transistor 24 of the voltage transformer circuit 15 is then conductive if a current flows to its base due to the discharge of the capacitor 16.

Please amend the paragraph beginning on line 23 page 6 with the following amended paragraph:

During the time period for which the first frequency signal of about 500 kHz is applied to the input 11, a high output voltage that is required to open the gas valve cannot be generated by the voltage transformer circuit 15 due to the high losses, in particular in the coil 26 and in the MOSFET transistor 30 of the voltage transformer circuit 15. Rather, this high output voltage is only generated when the second frequency signal with a frequency of about 10 kHz is applied to the input 11. When the second frequency signal of about 10 kHz is applied to the input 11, an output voltage V_{OUT} of more than 150 volts that is required to open the piezo-operated gas valve is generated from the supply voltage V_{BAT} by the voltage transformer circuit 15, and the capacitor 28 of the voltage transformer circuit 15 is charged.